

New Extant Species of Ironic Flies (Diptera: Ironomyiidae) with Notes on Ironomyiid Morphology and Relationships

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The Ironomyiidae or ironic flies (a family of lower Cyclorrhapha) are previously known from one Holocene Australian species and allegedly several Cretaceous or even Late Jurassic fossil species (Northern Hemisphere countries). Aspects of morphology are discussed, particularly that of the antenna and prelabrum ("clypeus" in error), and several alternatives as to possible phylogenetic relationships are mentioned. The Cretaceous genus *Lebambromyia* Grimaldi and Cumming is removed from the Ironomyiidae to incertae sedis (though possibly cyclorrhaphous), but the Jurassic-Cretaceous subfamily Sinolestinae is perhaps related to Ironomyiidae. A key to species of *Ironomyia* White is given. *Ironomyia francisi* sp. nov. and *I. whitei* sp. nov. are described from temperate eastern Australia.

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KEY WORDS: antennal sacculi, Australian endemic family, comparative morphology, living fossil, lower Cyclorrhapha, pedicellar button, phylogenetic relationships.

INTRODUCTION

The family Ironomyiidae was established by J. McAlpine and Martin (1966) for the extant Australian genus *Ironomyia*, which had previously been placed in the Empididae-Hybotinae (now Hybotidae), and later in the Platypezidae. Some Jurassic-Cretaceous fossil genera of the northern hemisphere have since been placed in the family (as discussed below), but, on the basis of Holocene (Recent) fauna, the Ironomyiidae remain one of the few families of Diptera endemic to Australia.

I class the Ironomyiidae as a living fossil taxon, because of their present limited diversity and distribution compared with those suggested by the fossil record, and because they show a degree of morphological stasis since their latest Cretaceous record (more than 70 m years ago), compared with the great majority of cyclorrhaphous families. Ironomyiids resemble monotremes (egg-laying mammals) in these respects, and also in that both groups are now restricted to the Australasian Region where each is represented by three living species. Whether the parallel between the two groups can be taken an additional step, and the Ironomyiidae can also be classed as the sister group to a taxon of major Holocene diversity, is a question for future research, as indicated below.

I include in the Appendix all genera mentioned in the text with their authors' names. I arrange these in a provisional classification which is based on a number of recent publications listed in References (including Stuckenberg 2001). This does not necessarily mean that I am convinced of the accuracy of every step in this classification. Wiegmann et al. (2003) presented an outline phylogeny of the lower (non-eremoneuran) Heterodactyla (which approximates to Muscomorpha of Woodley 1989, not of J. McAlpine 1989). These steps are omitted from my Appendix, as I have not referred to any included taxa in the present text. J. McAlpine (1989) hypothesised a monophyletic superfamily Platypezoidea including Ironomyiidae and the phoroid families, and Collins & Wiegmann (2002) found only limited support for such a clade. Further morphological considerations (some discussed below) suggest the possibility of alternative associations, and fossil studies (e.g. Grimaldi & Cumming 1999; Mostovski 1995) suggest very early origins for some lineages. Monophyly of the Aschiza (= Cyclorrhapha minus Schizophora), though supported by J. McAlpine (1989), is refuted by virtually all later studies. The taxon is therefore omitted from my classification, and I leave open several hypothesised associations among the lower cyclorrhaphans, avoiding use of formal names of new status. Classification above family level within the

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Schizophora is omitted as irrelevant to this present study, except that the acalyptrates are listed first. The spelling *Homoeodactyla* as used by Hennig (1973) and Sabrosky (1999) is considered most appropriate. I use the spellings *Asiliformae* and *Empidiformae* in accord with basic Latin grammar for taxa of above superfamily status but corresponding in content to the old superfamilies *Asiloidea* (some usages) and *Empidoidea*. These were originally termed *Asiliformia* and *Empidiformia* by Hennig (1948).

I use the term *ironic flies* (preferred German version *Ironiefliegen*) as a family-level common name for ironomyiids. This is simply a translation of the name of the type genus. Such common names have proved useful in communicating with non-specialists.

In my morphological study I have generally used a stereo light microscope (SLM), but for some work a compound light microscope (CLM) or scanning electron microscope (SEM) was used.

In listing material, the following abbreviations refer to institutions housing specimens:

AM	Australian Museum, Sydney
ANIC	Australian National Insect Collection, CSIRO, Canberra
BM	The Natural History Museum, London
CAS	California Academy of Sciences, San Francisco
CNC	Canadian National Collection, Agriculture Canada, Ottawa
UQ	University of Queensland Insect Collection, Brisbane

The following collectors' names are abbreviated to the initials: D.R. Britton, C.J. Burwell, J.M. Cumming, A. Daniels, G. Daniels, B.J. Day, E.D. Edwards, D.K. McAlpine, I.D. Naumann, E.S. Nielsen, N. Power, J.H. Skevington, E. Tasker, A. White, D. White, S. Winterton.

NOTES ON IRONOMYIID MORPHOLOGY

The following observations supplement the detailed study by J. McAlpine (1967). Other brachyceran taxa are mentioned for comparative purposes.

The Antenna

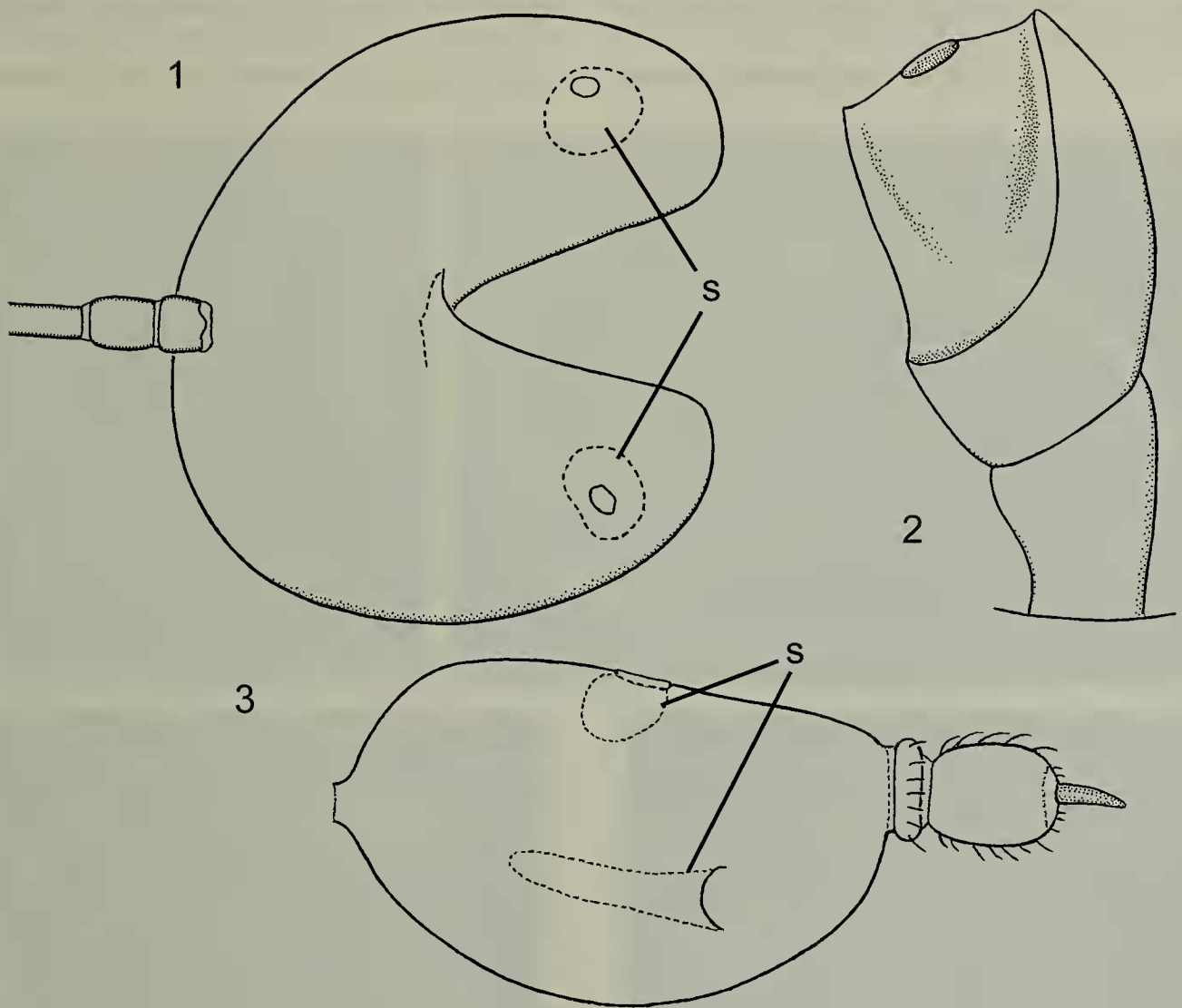
The antenna of *Ironomyia* (Figs 1, 2, 4, 6, 7) has an unusual structure for the lower Cyclorrhapha. The broadly rounded segment 3 (postpedicel) is compressed in an oblique plane so as to have broad dorsomedial and ventroexternal surfaces (state a), and has a transverse basal slot at right-angles to this plane,

dividing the basal part into two strongly gibbous projections. Each of these projections contains a complex sensory sacculus opening by a separate pore on its ventroexternal surface (state b). Segment 2 (or pedicel) has a stout, distally swollen conus (sensu Disney 1988b), fitted to the basal slot of segment 3, and also has an angular distal exposure or projection ("lobe") on each of the two surfaces (dorsomedial and ventroexternal). The conus is bridged on each side to one of these distal projections, so that, when exposed by removal of segment 3 (as in Fig. 6), it is not free distally (in contrast to that of Lonchopteridae, Sciadoceridae, and probably most taxa of Phoridae) (state c). The dorsoexternal and ventromedial surfaces of segment 2 each have a separate distally facing concavity receiving the corresponding basal projection of segment 3 (state d). The almost terminal three-segmented arista has a covering of numerous microtrichia extending as minute pubescence to the apex.

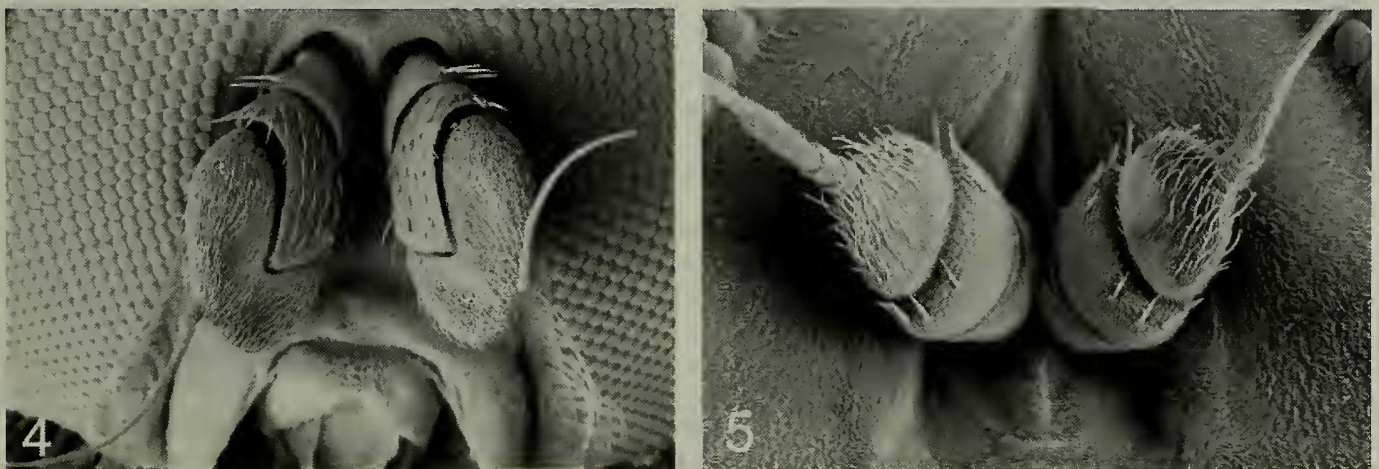
This antennal structure includes four apomorphic character states (a, b, c, d above) or one very complex apomorphic state, not known in other extant cyclorrhaphous taxa of pre-syrphoid grade.

The distal surface of the conus bears, on the outer side of the distal foramen, a **pedicellar button** (shown in Fig. 7). This is a new term for the smooth subcircular cuticular structure, having slightly sunken margins and surrounded by a smooth, convex cuticular ring, located on either the conus or the distal articular surface of segment 2. It is probably connected with a chordotonal organ, which is contained within segment 2. I have found the button to be present in **all** taxa of Cyclorrhapha, *Empidiformae*, and *Homoeodactyla* which I have examined adequately with SEM in a very preliminary survey (e.g. the platypezid *Lindneromyia*, Figs 8, 9), but, like the conus, it is only visible after removal of segment 3 from the more basal segments. As studies of the button and conus in the Cyclorrhapha are continuing, further details are reserved for a future publication.

I here use the term *sacculus*, following Lowne (1895: 586-589, pl. 41), for a deep, sac-like invagination of the cuticle of antennal segment 3, containing a number of sensilla and opening to the exterior by a relatively small pore. This structure is distinct from the often numerous simple pits in the cuticle, each of which is probably associated with a single sensillum, or various saucer-like pits that may contain several sensilla. In *Drosophila melanogaster* Meigen the sensilla in the sacculus are of several structural kinds. Some are olfactory and some have a "thermo-/hygro-sensitive" function (Stocker 2001). Because one or more sacculi are present in



Figures 1-3. 1, *Ironomyia nigromaculata* segment 3 and base of arista of left antenna, outer view. 2, the same, segments 1 and 2 dorsal view, setulae omitted. 3, *Hormopeza* sp., Yukon Territory, segment 3 and stylus of right antenna. s, sacculi.



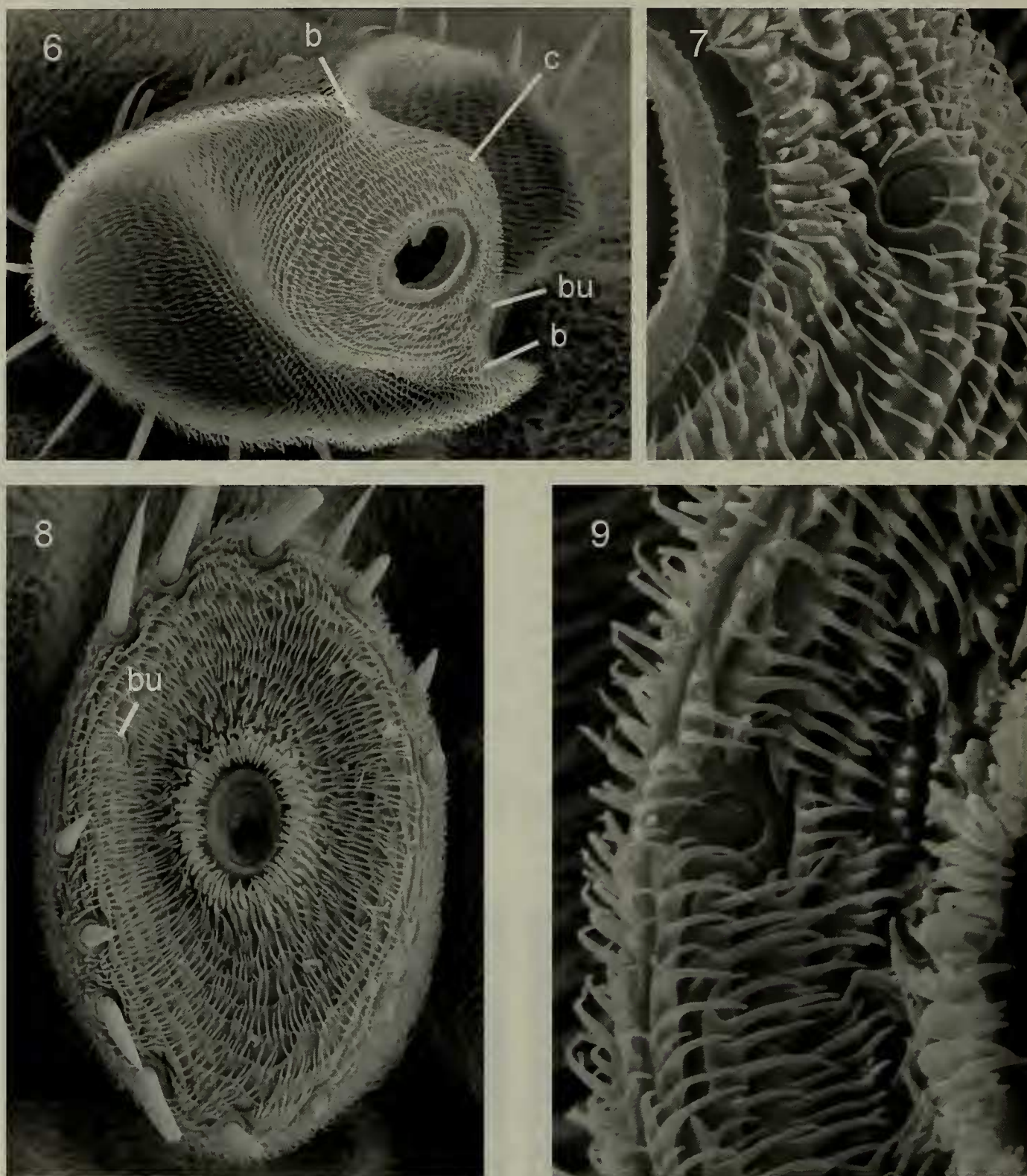
Figures 4, 5. 4, antennae of *Ironomyia nigromaculata*, male. 5, antennae of *Lindneromyia* sp., male.

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many cyclorrhaphous taxa and have so rarely been mentioned in the taxonomic literature, I briefly review the examples that have come to my attention.

J. McAlpine (1967) compared the 'reniform'

antennal segment 3 of *Ironomyia* with such rhagionid or athericid genera as *Symphoromyia*, *Suragina*, and *Atherix*. My examination of the superficially cyclorrhaphan-like antenna of the athericid



Figures 6-9. 6, *Ironomyia nigromaculata*, left antennal segment 2 after removal of segment 3, anterior view. b, bridges between distal projections and conus. bu, pedicellar button. c, conus. 7, same, detail of part of conus showing pedicellar button. 8, *Lindneromyia* sp., distal articular surface of right antennal segment 2, after removal of segment 3, pedicellar button indicated. bu, pedicellar button. 9, detail of part of same showing pedicellar button.

Suraginella shows (with CLM) that it lacks a sacculus in the ventrally gibbous segment 3, and that the long dorsal tubular arista, though unsegmented, has a minute attenuated solid apical section.

I have studied the antenna of the one available example of *Hormopeza* sp. (Empididae; ♀, Canada: Yukon Territory, CAS, see Fig. 3). Segment 3 contains two large, structurally different sacculi with remarkably wide external pores. One of these opens on the dorsal surface and one on the outer lateral surface of the segment. This is the only example of possession of sacculi known to me in the Empidiformae (or Empidoidea), though I have studied the antennae of only a meagre cross-section of empidiform taxa. Sinclair (1995) interpreted the style of *Hormopeza* as two-segmented with an apical bristle. This interpretation of the apical part as a bristle or enlarged macrotrichium appears to be justified by its solid structure and lack of pubescence, in contrast to the two preceding sections.

The antenna of *Sciadocera* lacks the sacculi in segment 3. Segment 2 is short in its externally visible surfaces, but has an elongate central knob, the conus, arising from the centre of its distal surface. The conus fits into a deep, rounded central basal cavity in segment 3 (Disney 2001: fig. 7) and bears the foramen of articulation on its terminal surface. In *S. rufomaculata* White segment 3 is so securely anchored to segment 2 by means of the conus that it cannot readily be disarticulated, even after the intersegmental connection is snapped by rotation.

In typical taxa of the Phoridae sacculi are absent (as far as I can determine without a major study), and relations between segments 2 and 3 are very like those of *Sciadocera*, but segment 2 tends to become more reduced so as to be often represented by little more than the concealed conus (Disney 1994: fig. 1.2). The antenna of *Lonchoptera furcata* (Fallén) (Lonchopteridae) also has a large conus and no sacculi, whereas that of *Melanderomyia kahli* Kessel, *Lindneromyia* spp., and probably other platypezids (Platypezidae) has no sacculus in segment 3 and an almost planate distal articular surface of segment 2 with only slight indication of a conus (Fig. 8). The antenna of the Lonchopteridae is thus much more like that of the sciadocerid-phorid alliance than that of any other lower cyclorrhaphous (aschizan) taxon. J. McAlpine (1989) is in error in stating that Lonchopteridae share with Platypezidae the absence of the conus ("apex of pedicel never deeply inserted into base of first flagellomere.")

A single large sacculus is probably usually present on the outer surface of segment 3 in the Syrphidae, though minor sensory pits may also be

evident [examples studied with CLM: *Microdon variegatus* (Walker), *Eristalis tenax* (Linné), *Melangyna* sp.]; but *Deineches* sp. apparently has numerous sacculi. *Eudorylas* sp. (Pipunculidae) also has one sacculus.

In the Schizophora one or more sacculi are usually present. The acalyptrate taxa generally have one sacculus [no exceptions yet confirmed; examples studied by me: *Liriomyza chenopodii* (Watt) (Agromyzidae), *Asteia* sp. (Asteiidae), *Aulacigaster* sp. (Aulacigastriidae), *Zalea major* (McAlpine) (Canacidae s.l.), *Clisa australis* (McAlpine) (Cypselosomatidae), *Scaptomyza australis* Malloch (Drosophilidae), numerous taxa of Ephydriidae, *Gobrya cyanea* (Enderlein) (Gobryidae), *Tapeigaster* spp., *Borboroides* spp., and *Heleomicra* sp. (Heteromyzidae s.l.), *Huttonina furcata* Tonnoir & Malloch (Huttoninidae), *Poecilohetaerus aquilus* Schneider, *Trigonometopsis* sp. (Lauханиidae), *Badisis ambulans* McAlpine, *Compsobata femoralis* (Meigen), *Cothornobata aczeli* McAlpine, *Metopochetus* spp., and *Mimegralla* spp. (Micropezidae), *Nemo centriseta* McAlpine (Neminidae), *Neurochaeta capilo* McAlpine, *Neurocytta prisca* (McAlpine), *Neurotaxis freidbergi* McAlpine, and *Nothoasteia clausa* McAlpine (Neurochaetidae), *Nothybus decorus* de Meijere (Nothybidae), *Teloneria* sp. (Neriidae), *Maorina* sp. (Pallopteridae), *Cyamops* sp. (Periscelididae), *Euprosopia armipes* McAlpine, *Lenophila coerulea* (Macquart), and *Rhytidortalis averni* McAlpine (Platystomatidae), *Lasionemopoda hirsuta* (de Meijere) (Sepsidae), *Strongylophthalmyia* sp. (Tanypezidae), *Somatia aestiva* (Fabricius) (Somatiidae), *Teratomyza undulata* McAlpine (Teratomyzidae)].

In the calyptrate Schizophora the number of sacculi in segment 3 is variable, but I have had time to examine very few taxa, especially as the usually darkly pigmented cuticle makes study more difficult. *Fannia canicularis* (Linné) (Muscidae or Fanniidae) has one major sacculus near the middle of the outer surface, but there are also numerous smaller, shallow pit-like structures, some of which contain several sensilla. *Scathophaga* sp. (Scathophagidae) has a sacculus on the outer surface and another on the medial surface nearer the base. *Musca vetustissima* Walker has one major subbasal sacculus only. *Calliphora augur* (Fabricius) (Calliphoridae) has apparently c. nine major sacculi. The statement by Lowne (1895: 586), that *C. vicina* Robineau-Desvoidy (as *C. erythrocephala*) has "about eighty large sacculi", apparently includes the smaller pits on the medial surface. *Chetogaster* sp. (Tachinidae) has one large sacculus on the outer surface and several

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smaller pits on the inner (medial) surface. In the Axiniidae (Colless 1994) there is commonly one sacculus ("sensory pore"), but it is multiple or absent in various taxa.

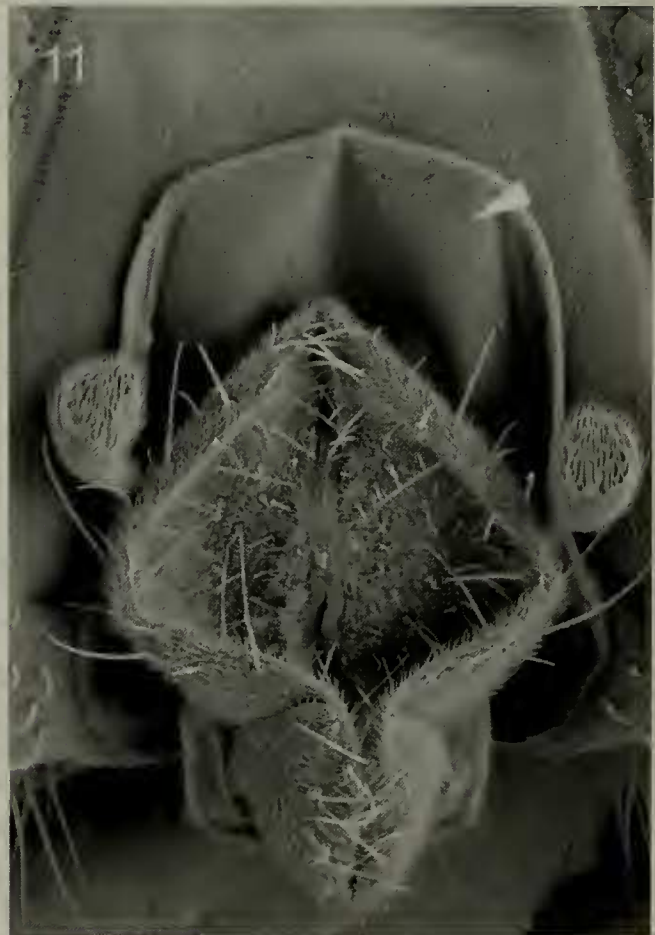
The presence of more or less separate dorsoexternal and ventromedial concavities (or, for comparative purposes, simply upper and lower concavities) on the distal articular surface of segment 2 of *Ironomyia* is interesting. Such separate concavities are absent in most cyclorrhaphous taxa of pre-syrphoid grade, including the platypezids *Lindneromyia* (Fig. 5) and *Melanderomyia* (the latter with a strongly bilaterally compressed segment 3), but are distinguishable in many syrphids, pipunculids, and schizophorans.

The arista of *Ironomyia* is three-segmented, as is probably also the case in the Cretaceous ironomyiid genus *Cretonomyia*. This is the most frequent condition in the Cyclorrhapha and is probably the groundplan condition, in contrast to that of most Empidiformae. However, fewer than three aristal segments are present in the Opetiidae, apparently in some lonchopterid-like and platypezid-like fossil taxa, in numerous taxa of Syrphidae,

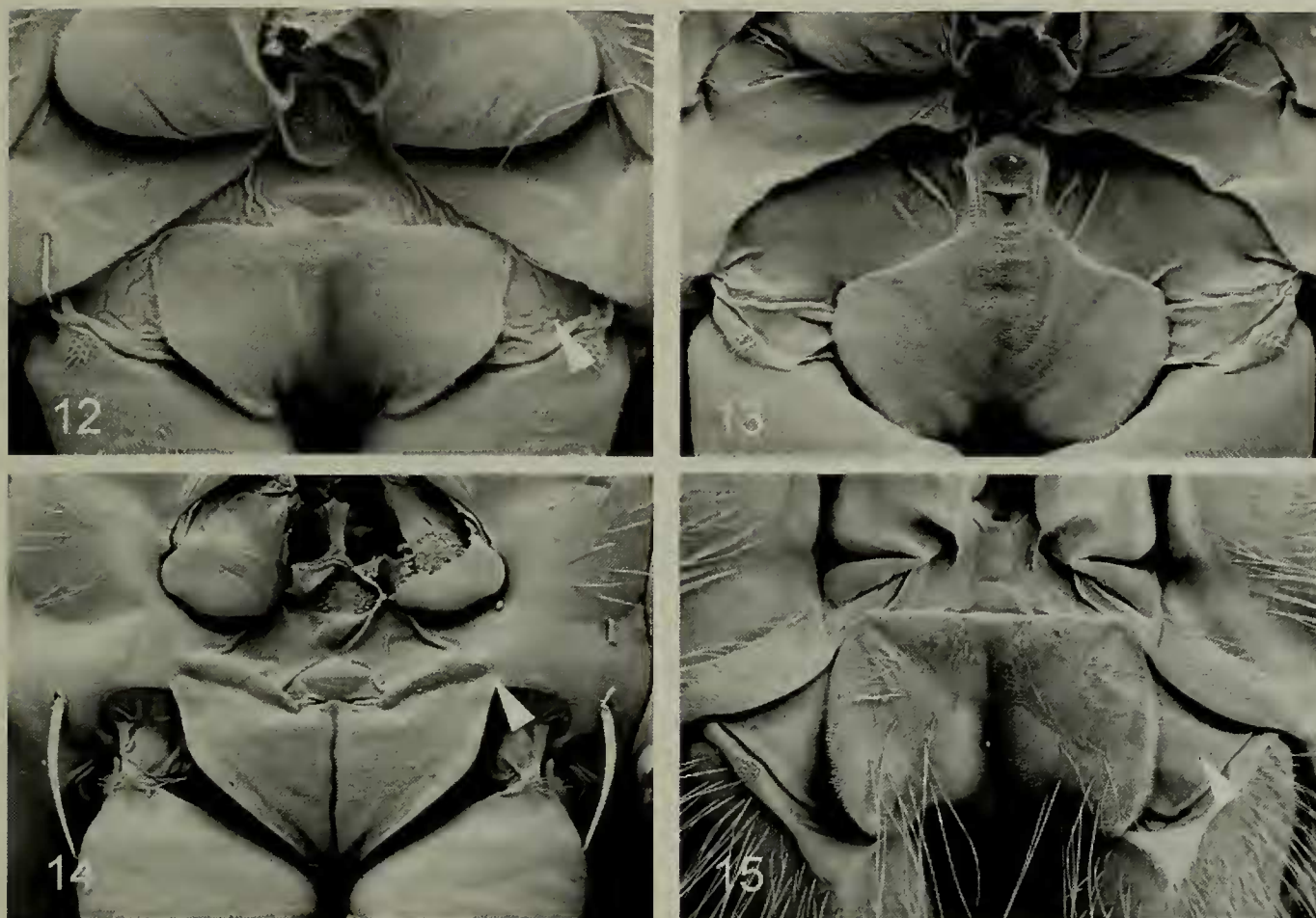
and in a sprinkling of taxa in numerous families of Schizophora (D. McAlpine 2002). Most or all of these examples represent derived character states and are of multiple origin.

The Prelabrum

The prelabrum of the Cyclorrhapha is often, with inadequate justification, homologised with the clypeus (J. McAlpine 1981) or sometimes with the (usually fused) tormae (e.g. J. McAlpine 1967: figs 1, 2). See D. McAlpine (2007) for discussion of this problem. In *Ironomyia* (Fig. 10) it is remarkably prominent and resembles that of many schizophorans in appearance. However, it differs from the latter in being very weakly sclerotised on its median section. I note that in *Sciadocera* and at least some platypezids (Fig. 11), the prelabrum is divided in two or almost so, a condition which suggests (but does not prove) its origin from paired sclerites, such as the tormae. In these taxa and in *Lonchoptera* the prelabrum is more or less flattened against the ventral surface of the head, in contrast to that of *Ironomyia*. In the Syrphidae and the Schizophora the prelabrum is generally undivided and broadly sclerotised across its median part.



Figures 10, 11. 10, *Ironomyia nigromaculata*, subcranial region of male. 11, *Lindneromyia* sp., subcranial region of male. Medially desclerotised prelabrum indicated for both taxa.



Figures 12-15. Prosternal region of cyclorrhaphous flies. 12, *Ironomyia nigromaculata*, subcoxal sclerite indicated. 13, *Lindneromyia* sp. 14, *Sciadocera rufomaculata*, precoxal bridge indicated. 15, *Eristalis tenax* (Linné), subcoxal sclerite indicated.

The prelabrum of all species of *Ironomyia* is sexually dimorphic, being larger in females. This condition may be correlated with dimorphism of the head capsule in taxa having holoptic tendency in the males. However, in some cyclorrhaphous taxa without male tendency to holopticism, the prelabrum of the female is significantly larger than that of the male – e.g. *Borboroides* spp. and *Heleomicra* spp. (Heleomyzidae s.l. or Heteromyzidae), *Rivellia* spp. (Platystomatidae), *Gluma* spp. (Coelopidae). *Strongylophthalmyia* spp. (Tanypezidae), *Acartophthalmus nigrinus* (Zetterstedt) (Acartophthalmidae), *Allometopon* spp. and *Tetrameringia ustulata* McAlpine (Clusiidae), *Traginops* sp. (Odiniidae), *Dasyrhicnoessa* spp. (Tethinidae or Canacidae); *Stenomicroa* sp. (sp. B in AM, Periscelididae). *Cyamops* spp. (Periscelididae) also have the prelabrum much smaller in the male, but in this genus the facial region of the head capsule, not the postfrons, is narrowed by encroachment of the eyes in the male.

The Prosternum

In *Ironomyia* the prosternum (Fig. 12) is a

very broad sclerite covering most of the ventral surface of the thorax in the space between the fore coxae. Its lateral margin forms a raised flange on each side, and next to the anterior part of the lateral margin there is a separate, often rather weakly defined, subtriangular sclerite – the subcoxal sclerite. Anterolaterally the prosternum is separated from the propleuron on each side by a membranous zone, i.e. there is no precoxal bridge. In the platypezids *Lindneromyia* (Fig. 13) and *Microsania* the prosternum is slightly narrower, with neither raised lateral margin nor precoxal bridge, and the subcoxal sclerite is at most vestigial. However, in the platypezid *Agathomyia*, I find a large triangular subcoxal sclerite. In *Sciadocera* (Fig. 14) the prosternum is broadly triangular, with slightly raised lateral margin and distinct precoxal bridge; no subcoxal sclerite is distinguishable in the position it occupies in *Ironomyia*, but a minute sclerotised spot near the anterior angle of the coxal base perhaps represents the subcoxal sclerite. Typical phorids generally have the prosternum very like that of *Sciadocera* but more narrowed posteriorly and without raised lateral margin. *Lonchoptera furcata* also has a

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similar prosternum, without visible subcoxal sclerite or raised lateral margin.

The Syrphidae show a range of shapes in the prosternum, but the following features are nearly always present (Fig. 15): the prosternum is broad with margin strongly raised and produced posterolaterally into a lobe on each side; the prosternum is isolated from the propleuron on each side, there being no precoxal bridge; the subcoxal sclerite is large and approximated to the lateral margin of the prosternum. This suite of characters is remarkably similar to that of *Ironomyia*, differing mainly in that the raised lateral margin forms a prominent posterolateral lobe on each side. The prosternum of the Pipunculidae and Conopidae, so far as I have observed it, looks like a reduced version of that of the Syrphidae, being generally more narrowed anteriorly, with the subcoxal sclerite little developed. In the Schizophora prosternal structure is very diverse (see Speight 1969), but, as the diversity is scarcely relevant to this study of Ironomyiidae, it is not treated here.

The Tarsus

Sawlines are present on the mid and hind tarsi of *Ironomyia* spp., except on the terminal segment of each. I have described these structures for the schizophoran families Syringogastridae and Diopsidae and mentioned their presence in a few other cyclorrhaphous families including Sciadoceridae, Phoridae, Platypezidae, and several families of Schizophora (D. McAlpine 1997: 172). The modified setulae comprising ironomyiid sawlines (Fig. 16) appear to lack the double structure seen in diopsoid flies (op. cit. figs 40-43).

In all three *Ironomyia* spp. segment 4 of the hind tarsus is very asymmetrical, on account of an elongate, subconical distally directed process on the

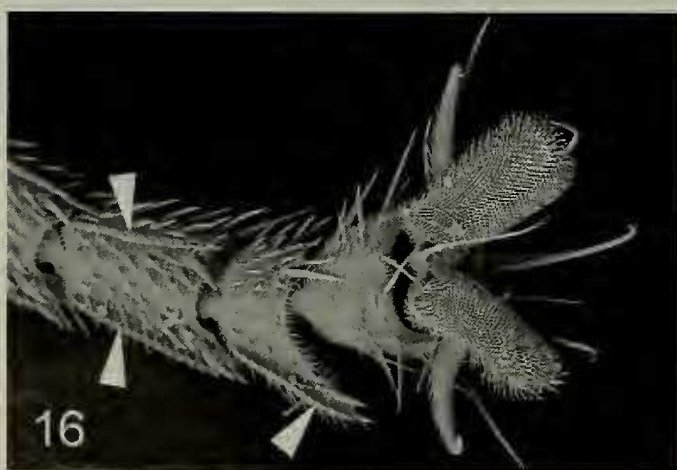
posterior side. This process bears a sawline and several other setulae, of which a subapical one is enlarged. It does not appear to be sexually dimorphic.

In *I. nigromaculata* the empodium consists of a pubescent, broadly tubercle-like basal plate, apically bearing a large, simple, upwardly curved setiform process with smooth surface, in contrast to the longitudinally sculptured setulae on segment 5 (Figs 16, 17).

In *Sciadocera rufomaculata* the empodium has the same basic structure as in *Ironomyia*, but is much smaller and the setiform process is not curved upwards. The hind tarsus shows strong sexual dimorphism. In the female, segment 4 is approximately symmetrical. In the male segment 4 is very asymmetrical, but of different form from that of *Ironomyia*, and it is the anterior, not the posterior, side that is strongly extended distally. Schmitz (1929) described the empodium of *Sciadocera* as 'pad-shaped and not bristle-like.' This is certainly not true for *Sciadocera* s.str., but he may have referred to the condition in *Archiphora*, which was then treated as a subgenus of *Sciadocera*, and which I have not examined. However, Schmitz admitted that he had a pair of *Sciadocera* (*Sciadocera*) *nigromaculata* for study.

The Wing

The wing venation of *Ironomyia* is probably quite diagnostic within the whole field of extant brachyceran flies (Fig. 23). The subcosta is free basally, but becomes fused with vein 1 (R_1) for more than one third of the wing-length, and diverges from it distally to terminate separately in the costa; vein 3 (R_{4+5}) is unbranched; the discal cell is well developed and distally separately emits three veins, each of which extends to the wing margin; the anal cell (CuP) is enclosed, moderately short and emits



Figures 16, 17. *Ironomyia nigromaculata*, parts of left hind leg. 16, distal part of tarsus ventral view, sawlines indicated. 17, terminal view of tarsus.

distally a long vein 6 ($CuA_1 + A_1$) which is distinctly sclerotised approximately to the margin. Also, the costa has two or three almost longitudinally aligned anteroventral costagial bristles. *Ironomyia* agrees with Sciadoceridae and Phoridae in that the costa terminates at the end of vein 3, whereas in typical platypezids it extends to vein 4. Disney (1988a) pointed out a close resemblance in costal chaetotaxy between Ironomyiidae and Sciadoceridae. Though he initially regarded the relevant character state as a synapomorphy, he later (Disney 2001) described it as 'probably a plesiomorphic feature', in order to support an alternative cladistic hypothesis.

In all specimens of *Ironomyia* that I have examined in detail, the anal region is broadened so that that part of its margin just beyond the alula is almost at right angles to the longitudinal axis of the wing (Fig. 23). However, in previously published illustrations of the wing of *I. nigromaculata* the anal region is erroneously shown as less prominent and more evenly rounded, presumably because it was furled or partly concealed in the available specimens. The part of the anal margin nearest the alula naturally possesses a series of elongate setulae, which vary considerably in number. These setulae are so fragile that they are often lost in preserved specimens.

The alula of *Ironomyia*, though not large, forms a better developed lobe than in Sciadoceridae and Phoridae. A distinct, pigmented ambient vein is present on its margin, and bears numerous setulae (socket-based macrotrichia), but has very limited extension on to the anal lobe.

The hair-fringe on the posterior margin of the wing beyond the anal lobe consists of microtrichia only, which, like those of most lower cyclorrhaphans other than Lonchopteridae, lack basal sockets.

The Preabdomen

In *Ironomyia* abdominal tergites 1 and 2 are separated by a narrow intersegmental membrane across the dorsal part of the abdomen but this membrane is discontinued for about one fifth of the total width of the tergite on each side, so that the two tergites become sclerotically continuous on this marginal region. A groove in the apparently uniformly sclerotised cuticle is all that defines the two tergites in this region, as there is no well defined marginal incision. By contrast, tergites 2 to 6 are all separated by complete intersegmental membranes.

My studies, which are far from a complete coverage of taxa, indicate that partial to complete fusion of tergites 1 and 2 is a general rule in the Cyclorrhapha. The only included groups in which these tergites are completely separated by a strip of

intersegmental membrane are, to my knowledge, the Opetiidae (Chandler 1998), Sciadoceridae (author's observation on *Sciadocera*), and Phoridae (author's limited observations and examples figured by Disney 1994). The Empidiformae usually have tergites 1 and 2 separate, and thus, if Empidiformae and Cyclorrhapha are sister groups, the separate condition is likely to be the groundplan condition for the Eremoneura. The resemblance between Ironomyiidae and the rest of the Cyclorrhapha (apparently including the Platypezidae) is interesting, but cannot at this stage be affirmed as a synapomorphy.

Chandler (2001) points out that the Platypezidae show so many plesiomorphic conditions that it has not yet been conclusively demonstrated how they differ from the groundplan of the Cyclorrhapha. At least partial fusion of tergites 1 and 2 occurs in the genera *Agathomyia*, *Lindneromyia*, *Melanderomyia*, and *Microsania* (my observations); so, if the condition proves to be uniformly present in the Platypezidae, this would be an apomorphic character state of the family relative to the groundplan of the Cyclorrhapha.

The Male Postabdomen

The male postabdomen of *Ironomyia* is essentially symmetrical; segment 6 has the tergite and sternite occupying their primitive, respectively dorsal and ventral positions; segment 7 is not represented by any sclerite, and sternite 8 is large, approximately symmetrical, dorsally located, and connate on its posterior margin with the epandrium. J. McAlpine (1967) terms sternite 8 "sternite 7+8", but there is no evidence for inclusion of any part of segment 7 in this sclerite, either in the groundplan of the Cyclorrhapha or in *Ironomyia*. In the Schizophora many taxa possess an identifiable, usually asymmetrical sternite 7, and a few taxa possess a small sclerite associated with right spiracle 7 which could be a vestige of tergite 7. The absence in *Ironomyia* of any sclerite representing segment 7 agrees with *Sciadocera* but differs from the Platypezidae. According to Chandler (1998: fig. 8), *Opetia* has the postabdominal segmentation even further reduced. J. McAlpine (1967) identifies the two median sclerites between the aedeagus and the cerci in *Ironomyia* as 'sternum 10?' and 'sternum 11?'. While I am also doubtful of the homologies of these sclerites, I provisionally use those designations.

FOSSILS

The fossil record (entirely Mesozoic) of apparent or possible ironomyiid flies has been reviewed by Mostovsky (1995) who provided a key

(in Russian); and Chandler (2001) made some general comments on the fossil taxa. Grimaldi and Cumming (1999) described an additional fossil taxon.

The only one of these fossil taxa which I consider to be unambiguously ironomyiid is *Cretonomyia pristina* J. McAlpine 1973, in Upper Cretaceous Canadian amber. The wing venation (including partial fusion of subcosta and vein 1) and visible detail of antennal segments 2 and 3 confirm the impression of a fairly general agreement with *Ironomyia* in other characters, though numerous morphological features of the unique fossil are not visible. Ironomyiidae s. str. (= subfamily Ironomyiinae of Mostovsky) includes only the genera *Ironomyia* and *Cretonomyia*.

Lebambromyia acraei Grimaldi & Cumming, 1999, was based on two specimens in lower Cretaceous Lebanese amber. The published details suggest cyclorrhaphous status for *Lebambromyia*, but in my view any synapomorphy with Ironomyiidae is at best doubtful. If the prelabrum is absent, then perhaps some doubt would be thrown on the cyclorrhaphous affinities of *Lebambromyia* (but the condition of the prelabrum is apparently also unrecorded for *Opetia*, which I have not examined). Grimaldi and Cumming mention the similarity between *Lebambromyia*, *Cretonomyia*, and *Ironomyia* in the sclerotised pterostigma confined to the subcostal cell. *Agathomyia* spp. (England, AM; New York state, AM) have a lightly sclerotised zone in the apex of the subcostal cell, and this appears to be present also in some other platypezids figured by Kessel (1987). I do not consider the presence of a pterostigma restricted to the subcostal cell to be a reliable diagnostic indicator for the Ironomyiidae.

Lebambromyia lacks what I consider to be diagnostic apomorphies for the Ironomyiidae, viz. the partial fusion of the subcosta with vein 1, and the highly specialised articulation between antennal segments 2 and 3. I find no acceptable evidence for inclusion of *Lebambromyia* in the Ironomyiidae and formally remove it from the family. Those making future studies of the genus should decide whether a new family is required for it.

The remaining fossil taxa previously referred to the Ironomyiidae are placed in the subfamily Sinolestinae by Mostovski (1995). These are impression fossils from the Upper Jurassic to Lower Cretaceous of northern Asia, and are thus among the very earliest putative cyclorrhaphans, if correctly identified as such. Included genera are: *Eridomyia*, *Hermaeomyia*, and *Palaeopetia* (syn. *Sinolestia*). Twenty-one nominal species are included. These flies have, except in the region of the subcosta, venation typical of the Platypezidae, with the fork

of vein 4 (M_{1+2}) located beyond the discal cell. The subcosta, beyond the base, becomes fused or connate for a considerable distance with vein 1, then becomes free distally so as to delimit basally, in at least some species, a short, apparently sclerotised or pigmented pterostigma. This condition of the subcosta in, for example, *Palaeopetia gemina* Mostovski (1995: fig. 1) is a precise replica of that in the Holocene *Ironomyia* (Fig. 23), but shows less resemblance to the Upper Cretaceous *Cretonomyia*, which has a much shorter extent of fusion between the subcosta and vein 1. It has been doubted if actual fusion between the subcosta and vein 1 can be demonstrated in the impression fossils, but the sinolestine specimens are fairly numerous, and the compression to which they have been subjected should emphasise any gap between veins in a percentage of specimens.

It is improbable that details of antennal structure would be preserved in these impression fossils, but the drawings by Mostovski sometimes indicate a more rotund segment 3 than is generally seen in the less specialised empidoidea and the Platypezidae (other than *Melanderomyia*). That of *Eridomyia captiosa* Mostovski shows antennae reminiscent of true ironomyiids, but I am unsure how much of the visible outline represents actual structure.

Without seeing any of these sinolestine fossils, I remain impressed by their resemblance to later ironomyiids, and suggest that the Sinolestinae remain provisionally in or near the Ironomyiidae until further evidence tends to confirm or negate this position.

PHYLOGENETIC CONSIDERATIONS

The Ironomyiidae share three possible synapomorphies with the probably monophyletic group Sciadoceridae + Phoridae (treated as one family by Tonnoir 1926, Disney 2001): (1) the subcosta becomes fused with vein 1 a short distance beyond base; (2) the costa extends to and is discontinued near vein 3 (in contrast to less reduced forms of Platypezidae, and probably also to Lonchopteridae and Opetiidae where it is continued as an ambient vein); (3) segment 7 of the male postabdomen has no distinguishable sclerite. In the Cretaceous ironomyiid *Cretonomyia* fusion between the subcosta and vein 1 commences much further from the base and continues for a much shorter distance than in *Ironomyia*; i.e. the subcosta is somewhat less phoroid in appearance. The case for synapomorphy between Ironomyiidae and the more typical phoroids is thus weakened, and homoplasy between, for example, *Ironomyia* and

Sciadocera becomes less unlikely. Also characters (2) and (3) can show instability in many cyclorrhaphous lineages, and are subject to frequent convergence.

Griffiths (1972) considered the Ironomyiidae + Sciadoceridae + Phoridae to constitute the clade Hypocera (Phoroidea is the name now preferred), and included two further autapomorphies for the group: "apex of second antennal article deeply inserted into base of third;" and "anal cell shortened." I reject these from the apomorphic evidence for inclusion of the Ironomyiidae in this alliance, because (1) the articulation between antennal segments 2 and 3 in *Ironomyia* is fundamentally different from that of the other two families as indicated above, (2) a well developed conus inserted into segment 3 is present in many cyclorrhaphous taxa, and (3) the anal cell (cup) of *Ironomyia* and *Cretonomyia* is only marginally shorter than that of numerous platypezid taxa and probably not as short as that of *Opetia*.

Ironomyia also differs from more typical taxa of the phoroid alliance in the absence of pubescence on the marginal setulae of the alula, in the partial fusion of abdominal tergites 1 and 2, and in the absence of prothoracic precoxal bridges. When on tree trunks or in glass containers, ironomyiids are inactive or walk slowly, in contrast to typical sciadocerids, phorids, and platypezids, which usually run actively.

The nature of the articulation between antennal segments 2 and 3, and the presence of well developed sensory sacculi in segment 3, appear to separate the Ironomyiidae from all other cyclorrhaphans of pre-syrphoid grade, so far as they have been investigated for these structures, but a few approaches to these ironomyiid-like conditions have been noted in certain taxa in the Empidiformae.

As an alternative hypothesis, two shared apparent apomorphies (?synapomorphies) suggest that the Ironomyiidae are closely related (? the sister group) to the Eumuscomorpha (= Syrphidae + Pipunculidae + Schizophora). These are: (1) antennal segment 3 containing one or more sensory sacculi; (2) antennal segment 2 with more or less separate upper and lower concavities on distal articular surface, which receive the upper and lower basal gibbosities of segment 3. Of these conjectured synapomorphies, I have particular reservation concerning (2). In such taxa as the platypezid *Lindneromyia* (Fig. 5) antennal segments 2 and 3 are only slightly bilaterally compressed, and this probably plesiomorphic approximation to radial symmetry round the central longitudinal axis results in the distal concavity of segment 2 being annular. In many syrphids, platypezids, and schizophorans these segments, particularly segment 3, have become

dilated and compressed and such annular concavity is consequently squeezed into upper and lower elements. But bilateral compression of segment 3 and the adjoining part of segment 2 has evolved several times in diverse non-cyclorrhaphous brachycerans (e.g. in Athericidae and Dolichopodidae). Such examples must throw a degree of doubt on any hypothesis of a single permissible origin of such compression in Cyclorrhapha. Nevertheless, I mention condition (2) because it is probably a groundplan condition of the three abovementioned main groups of Eumuscomorpha, as well as of *Ironomyia*; also because the platypezid *Melanderomyia*, with its strongly compressed segment 3, still lacks the distal concavities of segment 2. As explained above, the prominent, sexually dimorphic prelabrum of *Ironomyia* is, apart from its probably primitive bipartite structure, more like that of certain eumuscomorphous taxa than that of any other cyclorrhaphous taxon of presyrphoid grade. But much variation in the Eumuscomorpha creates difficulty in determining the groundplan condition of the prelabrum in this group.

The partial fusion of abdominal tergites 1 and 2 in *Ironomyia* is more in agreement with the Eumuscomorpha than with the Phoroidea, though it occurs also in some other lower cyclorrhaphans.

According to the study by Wada (1991), the Eumuscomorpha differ from all other cyclorrhaphans investigated in the nature of the sensory epithelium of the compound eyes. Unfortunately he was not able to examine *Ironomyia* for this condition.

If the fusion between the subcosta and vein 1 is a homologous condition through the Sinolestinae and Ironomyiidae s.str., then this apomorphy must have evolved in the lineage by the end of the Jurassic Period. The ancestral eumuscomorphan (on the assumption of monophyly for this group), having a more plesiomorphic subcosta, could not have been subsequently derived from such ironomyiid lineage.

It is now desirable that *Ironomyia* be incorporated into DNA phylogenetic studies, such as that of Collins & Wiegmann (2002), to test support for one of three conceivable alternatives: (1) Ironomyiidae are closest to the typical phoroid families Sciadoceridae and Phoridae; (2) Ironomyiidae are close to the Syrphidae and Pipunculidae or to the possibly monophyletic Eumuscomorpha; (3) Ironomyiidae are a very isolated group of lower cyclorrhaphans. If either alternative (2) or (3) is favoured, a separate superfamily would be necessary for the ironomyiids.

NEW SPECIES OF IRONIC FLIES

Genus *Ironomyia* White

Ironomyia White 1916: 216-217, fig. 39. Type species (monotypy) *I. nigromaculata* White.

Description

See J. McAlpine (1967).

Distribution

Queensland – as far north as Atherton Tableland. New South Wales – Coast districts to Western Slopes. Victoria – few records. Tasmania – probably widely distributed. In New South Wales and Queensland they extend from wet coastal districts to drier inland districts such as Mendooran and Millmerran. With further collecting, they will probably be found to have a wider distribution in Victoria, and it would not be surprising if they were discovered in South Australia and Western Australia.

Notes

This, the only extant genus of Ironomyiidae, shows very little structural diversity, and has been well described by J. McAlpine (1967). I give some further morphological data above. The wing venation (Fig. 23) is unique among Holocene Brachycera, and the structure of antennal segments 2 and 3 (Figs 1, 2) is also distinctive.

The flies generally live in forested country, where they are sometimes found on tree trunks (e.g. *Acacia* s.l.). They are also taken by light-trapping and occasionally by sweeping vegetation. They are most often found in late spring or early summer, but are generally uncommon.

Key to species of *Ironomyia*

- 1 Scutellum with dorsal setulae or mollisetae (in addition to marginal bristles, Fig. 19), or, if these (rarely) absent, then numerous marginal setulae located among marginal bristles; apex of scutellum without pale spot; abdominal tergites 2 to 6 each with black median zone; male: surstylus compressed, plate-like, with setulae little developed on anterior surface *nigromaculata* White
- Scutellum without either dorsal setulae or dorsal mollisetae, nor with setulae among marginal bristles, with yellowish apical spot (Fig. 21); median zone of tergites 2 to 6 pale grey to yellowish, flanked by black zone on each side (sometimes brown on tergite 6); male: surstylus not thus compressed, with very numerous long or rather short setulae on anterior surface 2
- 2 Wing with blackish apical spot covering end of

submarginal cell and adjacent parts of marginal and first posterior cells (Fig. 24); median pale zones on tergites 2-5 relatively narrow (Figs 27, 28); male: surstylus stoutly ovoid, with mixed large and small anterior setulae (Fig. 26)

..... *whitei* n.sp.

- Wing without distinct apical spot (apices of veins 2 and 3 often darkened); median pale zones on tergites 2-5 relatively broad (Fig. 22, broader in female); male: surstylus in profile curved, obliquely truncate, with numerous short setulae only on anterior surface (Fig. 25) ...*francisi* n.sp.

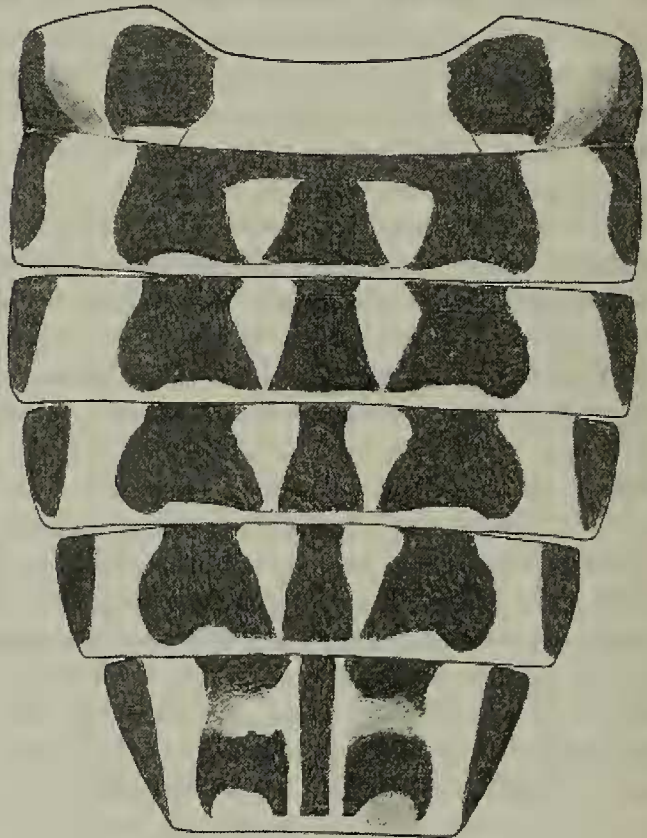


Figure 18. *Ironomyia nigromaculata*. Abdominal tergites 1-6 of male, diagrammatic, spread flat to show pattern.

Ironomyia nigromaculata White
Figs 1, 2, 4, 10, 12, 16-20

Ironomyia nigromaculata White 1916: 217-218, fig. 39; J. McAlpine 1967: 226-227, figs 1-15 (redescription).

Material examined (localities only)

Queensland: Hugh Nelson Range, S of Atherton (only known specimen from tropics, ANIC); Mount Moffatt vicinity, Carnarvon National Park (AM, UQ); Rainbow Beach, Tin Can Bay

district (AM); near Mount Glorious (UQ); Brisbane district – several localities (AM, UQ); 43 km WSW of Millmerran (AM); Tamborine Mountain (UQ); Amiens State Forest, W of Stanthorpe (AM). New South Wales: Dorrigo (ANIC); New England National Park (ANIC); Wollomombi Falls, Armidale district (AM); Warrumbungle National Park (AM, UQ); Carrai State Forest, W of Kempsey (AM); Goonoo State Forest, near Mendooran (AM); Kurrajong (AM); Mount Boyce, Blue Mountains (AM); Ku-ring-gai Chase National Park (AM); Royal National Park, S of Sydney (AM); Otford (AM); Macquarie Pass, near Albion Park (ANIC); Minnamurra Falls, W of Kiama (AM); Clyde Mountain, E of Braidwood (ANIC); Bawley Point, Ulladulla district (AM, ANIC); Depot Beach, near Bateman's Bay (ANIC). Victoria: 26 mi (c. 42 km) NNE of Orbost (ANIC); Young's Creek, 12 km N of Orbost (ANIC). Tasmania: Mount Barrow, near Launceston (AM); Cradle Valley (ANIC); Lake Saint Clair (ANIC); Bronte Park (ANIC); Franklin-Gordon Wild River Park (UQ); Hobart (**holotype** BM; ANIC); Arve River, Geeveston district (ANIC).

I have not examined the holotype, but J. Chainey has kindly checked its diagnostic characters

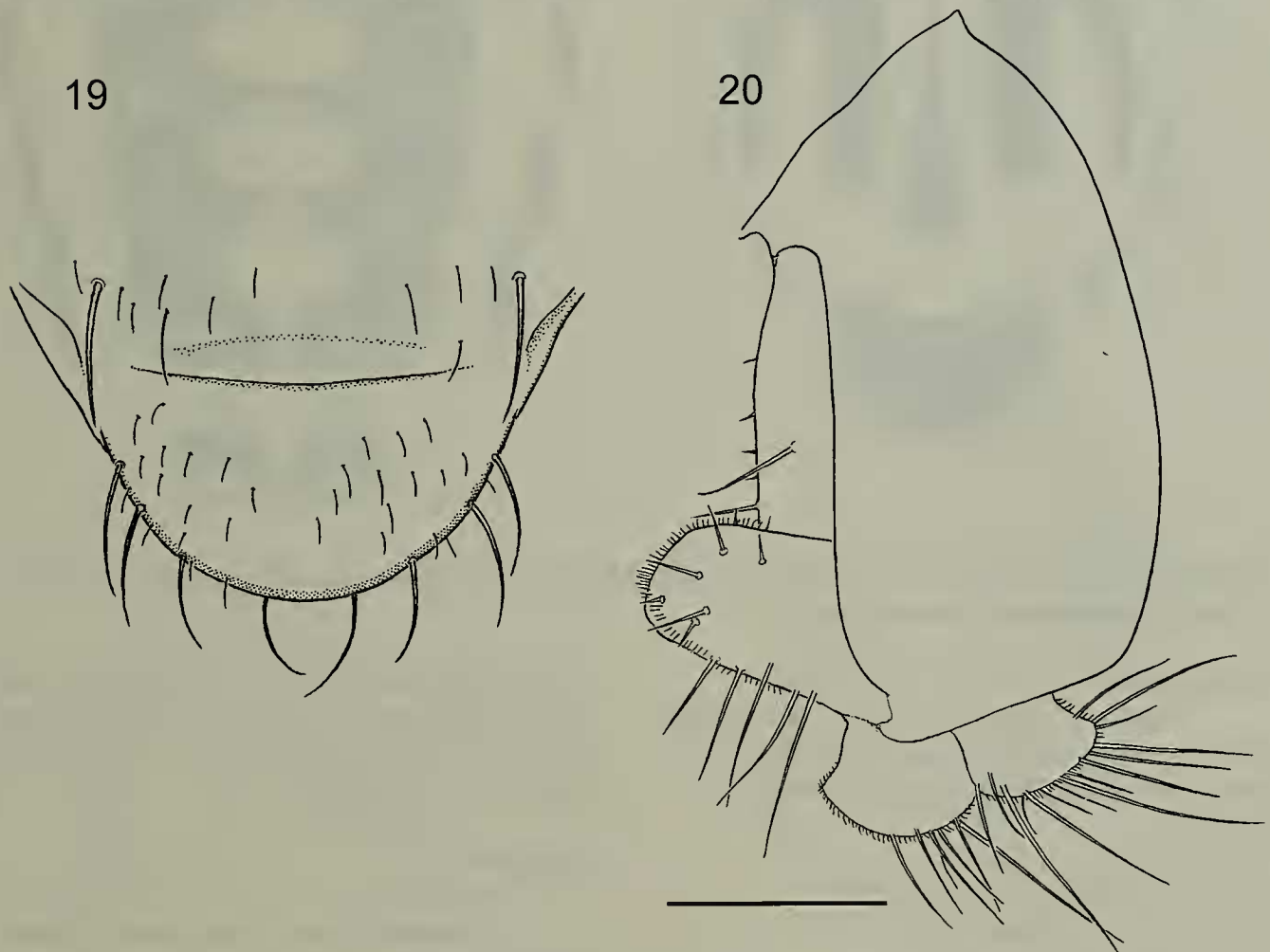
and confirmed (in litt.) the identification made here and by J. McAlpine (1967).

Description

See J. McAlpine (1967). I note some variation and some diagnostic characters in the relatively large series now available.

Coloration. Antennal segment 3 generally dark grey or grey-brown in southern populations, but specimens from Queensland usually with segment 3 yellow, as in *I. francisi* and *I. whitei*. Mesoscutal coloration sexually dimorphic as in *I. francisi*, but that of female more variable in width and extent of dark bands; scutellum always without pale apical zone. Dorsal abdominal pattern variable, but black zones generally more extensive in males than in females, (Fig. 18; J. McAlpine 1967: figs 4, 5) and often less extensive in southern Queensland specimens, but male from Hugh Nelson Range (northern known limit of range) as dark as any southern specimens; tergites 2 to 6 always with black median zone (J. McAlpine's fig 4 is in error regarding tergite 6, being based on a damaged specimens which I have checked).

Thorax. Scutellum with few to numerous



Figures 19, 20. *Iromomyia nigromaculata*. 19, scutellum, dorsal view. 20, epandrium and associated parts, left lateral view, scale = 0.1 mm.

NEW SPECIES OF IRONIC FLIES

dorsal setulae, often fewer in northern populations, specimen from Hugh Nelson Range with setulae interspersed with marginal bristles, but apparently no dorsal setulae.

Male postabdomen. Epandrium relatively stout; surstylus more compressed and plate-like than in other species, with very oblique base and broadly rounded apex, setulosity on anterior surface little developed; hypandrium broadly rounded anteriorly; cerci and sternite 11 located more terminally than dorsally on epandrium; sternite 11 broader than in other species.

Dimensions. Total length, ♂ 3.7-6.0 mm, ♀ 2.9-6.2 mm; length of thorax, ♂ 1.5-2.5 mm, ♀ 1.3-2.5 mm; length of wing, ♂ 4.2-6.4 mm, ♀ 3.6-6.9 mm.

Brisbane Forest Park, near The Gap, 27°25'41"S 152°50'18"E, 28.ix.-15.x.2002, J.H.S. & J.M.C., Malaise trap (J.H.S. #13323, AM). Glued to small card point.

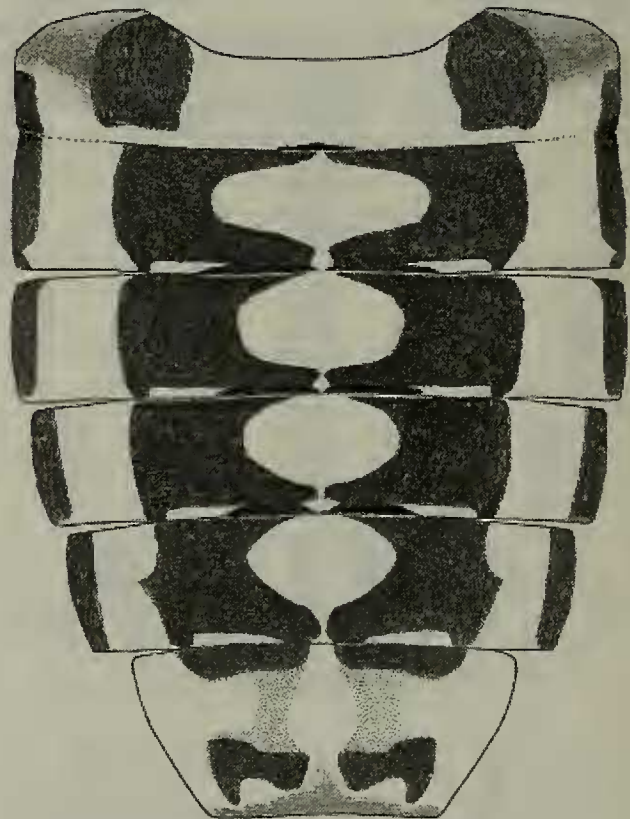
Paratypes. Queensland: 2 ♂, 4 ♀, same data as holotype (AM, ANIC): 1 ♂, Scrub Road, Brisbane Forest Park, 3-10.x.1997, S.W., N.P., D.W. (UQ); 1 ♂, 1 ♀, W of Highvale, near Samford, 27°23'S, 152°47'E, 19.ix.1986, G.D. (UQ); 2 ♂, 3.5 and 4 km WSW of Point Lookout, North Stradbroke I., 3-5.iv.1992, G.D., C.J.B. (UQ); 1 ♂, North Stradbroke I., 4.vi.1987, C.J.B. (UQ).

Other material. New South Wales: 1 ♂, 24 km W of South Grafton, 29°37'S, 152°44'E, 1.xii.1990, A.D., G.D. (AM); 4 ♀, Mooney Mooney Creek, near Gosford, 20-29.xi.1975, 1.xii.1989, B.J.D.,

21



22



Figures 21, 22. *Ironomyia francisi*. 21, dorsal view of thorax of female to show pattern. 22, tergites 1-6 of male, diagrammatic, showing pattern.

Distribution

Eastern Australia: Atherton Tableland (Queensland) to southern Tasmania. Records cover almost the whole known range of the genus.

Ironomyia francisi sp. nov.

Figs 21-23, 25

Material examined

Holotype. ♂, Queensland: Scrub Creek,

G.D., D.K.M. (AM, CNC); 1 ♀, Sydney, no other original data (ANIC); 1 ♂, 3 km E of Wedderburn, Campbelltown district, 34°08'S 150°49'E, 19.x.2003, D.R.B. (AM, in alcohol).

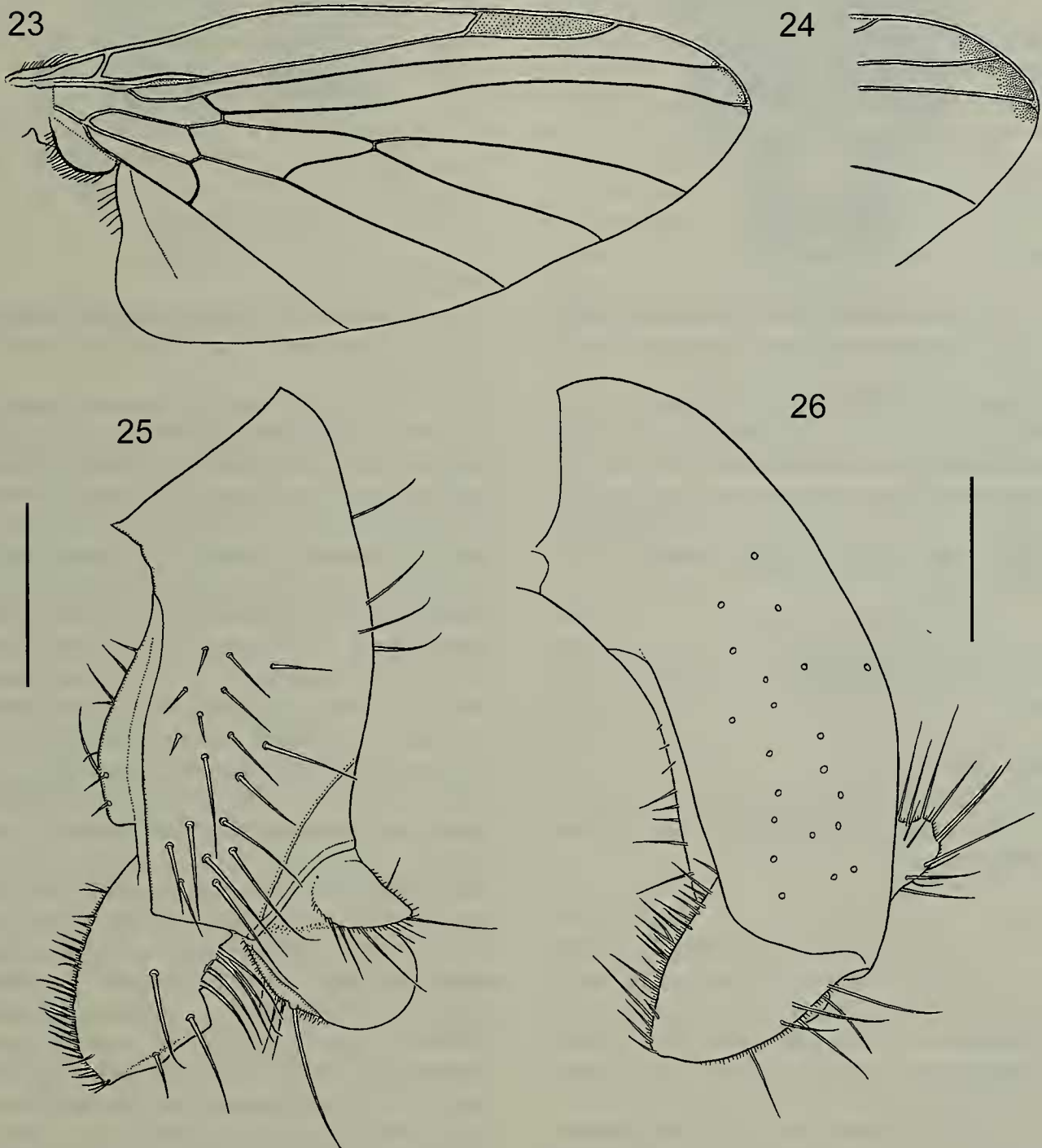
Description (♂, ♀)

With the general morphology of the genus.

Coloration. Head grey, largely densely pruinose; most setulae black; subgenal region largely shining brown. Antenna yellow, with brown arista. Sclerotised lateral part of prelabrum with

shining brown zone which is larger in female; median desclerotised part of prelabrum grey-pruinescent; palpus largely black, with variable yellow to brownish apical zone. Thorax largely grey to greyish-brown pruinescent; mesoscutum of male dark brown, becoming grey posteriorly, intensity and extent of colour-zones changing with angle of view, goldish zones on and near notopleural areas visible from some angles; mesoscutum of female (Fig. 21) grey with complex pattern consisting essentially of five longitudinal dark brown stripes and a dark blotch in front of each postalar callus; scutellum brown-black,

with grey to yellowish anterolateral zone on each side and yellowish apical spot which is larger in female. Legs largely grey-brown; femora apically yellowish; tibiae yellowish, each with diffuse brown sub-basal ring; mid and hind tibiae with, in addition, brown subapical ring, that on hind tibia much larger and darker; tarsi yellowish, each usually with terminal segment variably browned. Wing clear; pterostigma buff to pale brown; part of costa adjoining end of veins 2 and 3 slightly darkened, with very little brown pigment often visible on membrane at ends of these veins. Halter yellowish, with capitellum dark brown.



Figures 23-26. 23, *Ironomyia francisi*, wing. 24, *I. whitei*, wing tip. 25, *I. francisi*, epandrium and associated parts, left lateral view. 26, *I. whitei*, the same. Scale for Figs 25 and 26 = 0.1 mm.

NEW SPECIES OF IRONIC FLIES

Abdominal tergites 1 to 6 variegated black and pale yellowish grey, approximately as in Fig. 22 in male, with median pale zones broader in female, but extent of zones changing with angle of view so that median pale zones appear much darker in anterodorsal view; tergite 6 lacking median black zone.

Head structurally similar to that of *I. nigromaculata*.

Thorax. Scutellum quite without dorsal setulae, with three or four pairs of marginal bristles often irregular and asymmetrical.

Male postabdomen. Epandrium more slender than in *I. nigromaculata*, slightly narrowed basally, setulose, most strongly so laterally on posterior half, with well sclerotised anteroventral bridge in front of hypandrium, with posterodorsal bight for insertion of proctiger longer than in other species; surstylus stout but somewhat curved, distally obliquely truncate so that anterodistal angle is more acute than posterodistal angle, with relatively few large setulae posteriorly, and with numerous rather dense short setulae on anterior surface; hypandrium relatively slender, consisting of pair of narrow, anteriorly converging and shortly fused plates with mostly small setulae; aedeagus moderately elongate, sclerotised, curved, relatively slender beyond base, with slender basal apodeme; cerci well separated, setulose, markedly narrower than in *I. nigromaculata* and *I. whitei*; proctiger glabrous; apparent sternite 10 with pair of rounded finely setulose prominences between bases of surstyli; apparent sternite 11 narrower than in *I. nigromaculata*, with pair of large setulae and several small setulae.

Dimensions. Total length, ♂ 2.9-3.8 mm, ♀ 2.7-3.4 mm; length of thorax, ♂ 1.2-1.7 mm, ♀ 1.3-1.6 mm; length of wing, ♂ 3.3-4.1 mm, ♀ 3.4-4.1 mm.

Distribution

Queensland: Brisbane district and North Stradbroke Island. New South Wales: Grafton district to Sydney district.

Notes

I. francisi is readily distinguished from *I. nigromaculata* by having a pale median zone on tergites 2 to 6 and no dorsal or seriate marginal setulae on the scutellum. It also differs in details of the male postabdomen as in above description and Fig. 25. For comparison with *I. whitei* see under that species.

The specimens that I collected at Mooney Mooney Creek were found on trunks of *Acacia* sp. Most of the Queensland specimens were taken in Malaise traps or at mercury vapour light.

The specific epithet refers to James Francis (Frank) McAlpine, who established the family Ironomyiidae (with J.E.H. Martin) and contributed much to knowledge of its morphology and relationships.

Ironomyia whitei sp. nov.

Figs 24, 26-28

Material examined

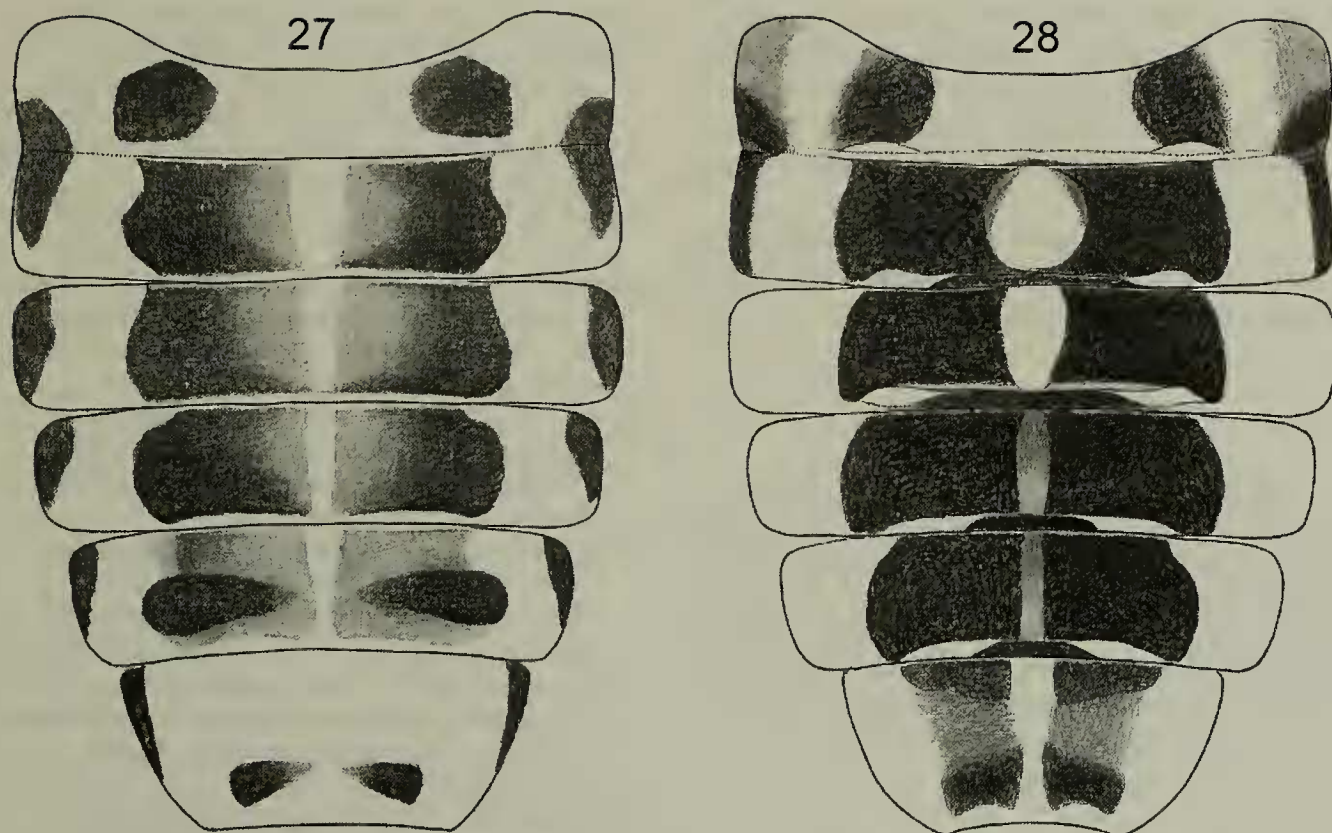
Holotype. ♂, Tasmania: Pieman River, near Rosebery, 15.i.1960, D.K.M. (AM).

Paratypes. Tasmania: 1 ♀, Pelion (Mount Pelion vicinity, Cradle Mountain-Lake Saint Clair National Park), iii.1990, I.D.N. (ANIC); 1 ♀, Clayton's, near Melaleuca, Bathurst Harbour district, 43°23'S 146°08'E, i.1991, E.S.N., E.D.E. (ANIC). New South Wales: 1 ♀, Carrai State Forest, W of Kempsey, 30°54'33"S 152°16'28"E, 3-8.xii.1997, E.T. (AM).

Description

Resembling *I. francisi* in most characters and agreeing with description of that species, except as indicated below.

Coloration. Head and antenna largely as given for *I. francisi*. Palpus almost entirely blackish in male, with tawny-brown apex in female. Mesoscutum and scutellum with sexually dimorphic pattern resembling that of *I. francisi*. Legs with markings possibly resembling those of *I. francisi* but all specimens somewhat faded. Wing with pterostigma brown (darker in less faded holotype); apical brown zone covering veins 2 and 3 and intervening area. Abdominal pattern of male (Fig. 28): tergite 1 broadly yellow-grey medially, with black paramedian zones, yellowish brown lateral parts, and posterior part of lateral margin black; posterior margin largely pale, with transverse silvery-pruinescent zone on each side; tergite 2 with moderately small, rounded pale median zone, which appears yellowish in anterodorsal view, silvery and slightly larger in posterodorsal view, with large black zone on each side of median zone, with lateral parts pale yellowish grey, and extreme lateral margin apparently black; central part of posterior margin black; sublateral part with transverse silvery pruinescent zone; tergites 3 and 5 resembling tergite 2, but median pale zone progressively narrower (lateral margins not visible); tergite 4 also generally similar to above, but narrow median pale zone consisting of silvery pruinescence on a largely brown to blackish ground-colour, so that this zone largely disappears in anterodorsal view; tergite 6 tawny-yellow with two



Figures 27, 28. *Ironomyia whitei*. 27, female tergites 1-6, diagrammatic. 28, male tergites 1-6.

pairs of dark brown zones connected on each side by zone of brown suffusion, and with entire median zone and posterior margin tawny-yellow. Abdominal pattern of female: somewhat resembling that of male; tergites 2 to 5 with narrow median stripe of silvery pruinescence (most distinct in posterodorsal view) either located on broader zone of yellowish ground colour which grades into darker paramedian zone, or delimited laterally by such dark zone; tergite 6 variable, with only the posterior pair of blackish brown zones (Carrai specimen, Fig. 27) or more extensively darkened (Tasmanian specimens).

Thorax. Scutellum with two or three pairs of marginal bristles, without dorsal setulae.

Male postabdomen. Epandrium as described for *I. francisi*, but much more elongate, slightly gibbous basally; surstylus very stout, with medially inclined subacute to narrowly obtuse (depending on angle of view) apex, with numerous small and large setulae on anterior surface and few large setulae on and near posterior surface; hypandrium much tapered anteriorly, not divided except at posterior end around base of aedeagus; aedeagus larger than in *I. nigromaculata*, stouter than in *I. francisi* and not tapered; cercus broader than in *I. francisi*; sternite 10 relatively broad, with slight convexity on each side; sternite 11 as described for *I. francisi*.

Dimensions. Total length, ♂ 3.1 mm, ♀ 3.3-3.7 mm; length of thorax, ♂ 1.6 mm, ♀ 1.3-1.6 mm; length of wing, ♂ c. 4.5 mm, ♀ c. 3.9-5.0 mm.

Distribution

Tasmania: western parts of state. New South Wales: eastern edge of Northern Tablelands district.

Notes

I. whitei is readily distinguished from other species of *Ironomyia* by the obvious dark brown to blackish apical wing spot (represented at most by a trace in other species), also by the distinctive colour pattern of the abdominal tergites (Figs 27, 28) and details of the male genitalia (Fig. 26).

In the holotype (the only known male) I have not been able to confirm the presence of a black lateral marginal zone on most abdominal tergites and have omitted them from Fig. 28, though they may be present. Females from Tasmania have the black zones on the tergites more extensive than that from Carrai Forest, New South Wales (Fig. 27), but observed variation is no greater than that in *I. nigromaculata*.

This species has been rarely collected. I obtained many flies by sweeping vegetation during an exceptionally hot day in a relatively cool rainforest gully leading to the Pieman River, near Rosebery,

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Tasmania, in Jan. 1960. These included heleomyzids (genera *Austroleria* McAlpine, *Diplogeomyza* Hendel, *Trixoleria* McAlpine), lauxaniids (genera *Ceratolauxania* Hendel, *Incurviseta* Malloch, *Sapromyza* s.l.), and other flies including the holotype of *Ironomyia whitei*.

The specific epithet refers to Arthur White, pioneer student of Tasmanian Diptera, who named the genera *Ironomyia* and *Sciadocera*.

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APPENDIX

Classification of genera mentioned in text.

Suborder Brachycera

 Infraorder Homoeodactyla

 Athericidae

Atherix Meigen

Suragina Walker

Suraginella Stuckenberg

 Rhagionidae

Symphoromyia Frauenfeld

 Infraorder Heterodactyla s.l.

 Division Asiliformae

 Division Eremoneura

 Subdivision Empidiformae

 Empididae

Hormopeza Zetterstedt

 Subdivision Cyclorrhapha

 Informal grade 'lower Cyclorrhapha' s.str

 Opetiid group

 Opetiidae

Opetia Meigen

 Platypezoidea

 Platypezidae

Agathomyia Verrall

Lindneromyia Kessel

Melanderomyia Kessel

Microsania Zetterstedt

 Lonchopteroidea

 Lonchopteridae

Lonchoptera Meigen

 Phoroidea

 Sciadoceridae

Archiphora Schmitz

Sciadocera White

 Phoridae

 Sinolestine group

 Sinolestinae

Eridomyia Mostovski

Hermaeomyia Mostovski

Palaeopetia Zhang (= *Sinolesta* Hong & Wang)

 Ironomyiid group

 Ironomyiidae

Cretonomyia J. McAlpine

Ironomyia White

 Uncertain group

Lebambromyia Grimaldi & Cumming

 Cohort Eumuscomorpha

 Syrphid group

 Syrphidae

Deineches Walker

Eristalis Latreille

Melangyna Verrall

Microdon Meigen

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- Pipunculid group
Pipunculidae
Eudorylas Aczél
- Group Schizophora
Acartophthalmidae
Acartophthalmus Czerny
- Agromyzidae
Liriomyza Mik
- Asteiidae
Asteia Meigen
- Aulacigastridae
Aulacigaster Macquart
- Canacidae (including Tethinidae)
Dasyrhicnoessa Hendel
Zalea D. McAlpine
- Clusiidae
Allometopon Kertész
Tetrameringia D. McAlpine
- Coelopidae
Gluma D. McAlpine
- Cypselosomatidae
Clisa D. McAlpine
- Drosophilidae
Drosophila Fallén
Scaptomyza Hardy
- Ephydriidae
- Gobryidae
Gobrya Walker
- Heteromyzidae (Heleomyzidae) s.l.
Austroleria D. McAlpine
Borboroides Malloch
Diplogeomyza Hendel
Heleomicra D. McAlpine
Tapeigaster Macquart
Trixoleria D. McAlpine
- Huttoninidae
Huttonina Tonnoir & Malloch
- Lauxaniidae
Ceratolauxania Hendel
Incurviseta Malloch
Sapromyza Fallén
- Micropezidae
Badisis D. McAlpine
Compsobata Czerny
Cothornobata Czerny
Metopochetus Enderlein
Mimegralla Rondani
- Neminidae
Nemo D. McAlpine
- Neurochaetidae
Neurochaeta D. McAlpine
Neurocytta D. McAlpine
Neurotaxis D. McAlpine
Nothoasteia Malloch

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- Nothybidae
Nothybus Rondani
- Neriidae
Telonerius Aczél
- Odiniidae
Traginops Coquillett
- Pallopteridae
Maorina Malloch
- Periscelididae
Cyamops Melander
Stenomicra Coquillett
- Platystomatidae
Euprosopia Macquart
Lenophila Guérin-Méneville
Rivellia Robineau-Desvoidy
Rhytidortalis Hendel
- Sepsidae
Lasionemopoda Duda
- Somatiidae
Somatia Schiner
- Tanypezidae
Strongylophthalmyia Heller
- Teratomyzidae
Teratomyza Malloch
- Calliphoridae
Calliphora Robineau-Desvoidy
- Muscidae s.l.
Fannia Robineau-Desvoidy
Musca Linné
- Scathophagidae
Scathophaga Meigen
- Tachinidae
Chetogaster Macquart